ANNALS

OF

The Entomological Society of America

Volume I SEPTEMBER, 1908 Number 3

A MONOGRAPHIC CATALOGUE OF THE MYMARID GENUS ALAPTUS HALIDAY, WITH DESCRIPTIONS OF THREE NEW NORTH AMERICAN FORMS AND OF ALAPTUS ICERYAE RILEY FROM TYPE MATERIAL.

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INTRODUCTION.

This paper is a catalogue monographic in nature, purely from the fact that as the species of the genus are listed, the original descriptions are quoted; it is not a monograph, as the types of most of the species have been inaccessible. Neither is the history of the genus touched upon to any extent on account of the lack of literature. Simply as a matter of convenience, the original descriptions of the species are given with the descriptions of the three new species here included, so that the descriptions of all the species of the genus are brought together. A preliminary bibliography of the species is also given, but it may be stated that the literature of the group is most fragmentary.

The forms in this genus are so minute and delicate, and their preservation so difficult, that it is not surprising that the types have in the main been lost, or no attempt made to keep them. The similarity of the various species in structure and color makes this most unfortunate, especially as most of the original descriptions are very inadequate. I have found that antennal structures afford the best specific characters, and these have in the main, received no attention from former systematic workers in this group. Some of the descriptions mean nothing at all, and on this account, it is a question whether the species described can be again recognized.

HOST RELATIONS OF THE GENUS.

Although the Mymaridae are supposed to be mainly egg-parasites, or we think of them mostly in that connection, yet this genus appears to be principally parasitic on various Coccidae; of the eleven species now described, the host relations of but four are definitely known, namely, the three new forms herein described and iceryae Riley; three of these were reared from some stage of various Coccidae (iceryae from the male pupa of Icerya); the other, caecilii, from psocid eggs. Hence even with these four species, there remains some doubt as to the stage of the host, excepting in the case of caecilii, and Icerya as the host of iceryae. In these last two cases the record is definite.

The host relations of the European species are unknown excepting in the case of excisus Westwood which is stated to have been reared : "from white blotches on oak leaves, evidently caused by the action of the minute larva of one of the leaf-mining Tineae (Lithocolletes?). The blotches were about 1¼ in. in diameter. The leaves were gathered on the 9th of September, 1871; and the little Mymars appeared on the 6th of October; one of the moths appeared on the 16th of September, 1871, and two other kinds of parasitic flies on the 4th of October following." (Westwood, 1879). The Australian species, immaturus Perkins, was reared "from cane leaves containing leaf-hopper eggs", but Perkins continues, "I do not feel sure that it is parasitic on these." (Perkins, 1905).

So far as the evidence goes, then, species of this genus have been reared from the eggs of Jassidae and Psocidae—immaturus Perkins (doubtfully) and caecilii Girault, respectively, the male pupae of Icerya (iceryae Riley), an aleyrodid (caecilii Girault, doubtfully), and unknown stages of the following—a tineid (excisus Westwood), and various Coccidae (globosicornis Girault, eriococci Girault, iceryae Riley). It is indicated, however, that the species are not restricted to one host only, and in order to show this more clearly, as well as to show the host relations, the following table is inserted.

It is seen from the table that the hosts of five of the species are entirely unknown (fusculus, fuscus, minimus, pallidicornis and pallipes); that in the case of two of the species (immaturus, excisus) the host is doubtful, and that with the exception of caecilii from eggs of Caecilius aurantiacus Hagen and iceryae

from the pupa of Icerya purchasi Maskell, the stage of the host is not definitely known for the four remaining species (caecilii, eriococci, globosicornis and iceryae.) Of the two undisputedly correct records, one of the hosts is a coccid pupa, and the other a psocid egg.

TABLE I. Tabular view of the recorded host relations of the species of Alaptus.

Parasite-Alaptus:	Host.	Stage of Host.	Remarks.
1. caecilii Girault	Caecilius aurantiacus Hagen	egg	
	Psocid	egg	undetermined
	Aleyrodes fernaldi Morrill	?	doubtful
2. eriococci Girault	Eriococcus araucariae Maskell	?	
	Chrysomphalus aurantii Maskell	?	
3. excisus Westwood	A tineid	?	a
4. fusculus Walker	?	?	
5. fuscus Foerster	?	?	
6. globosicornis Girault	Lepidosaphes beckii (Newman)	?	
7. iceryae Riley	Icerya purchasi Maskell	Male pupa.	
	Aspidiotus rapax Comstock	?	
8. immaturus Perkins	Jassidae	egg	doubtful
9. minimus Walker	?		
10. pallidicornis Foerster	?		
11. pallipes Ashmead	?		

a. This is doubtful, from the nature of the host, unless the egg was infested. Cf Riley and Howard, 1893.

DISTRIBUTION OF THE GENUS.

The species of the genus Alaptus occur in widely separated localities and the genus is represented in three continents: Europe (including England), North America and Australia. The species known to occur in Europe are excisus Westwood (England?; Austria—Dalla Torre, 1898), fusculus Walker (England), fuscus Foerster (Switzerland), minimus Walker (England), and pallidicornis Foerster (Germany); the North American species are pallipes Ashmead (Florida), iceryae Riley (California), globosicornis Girault (Florida), caecilii Girault (Florida, California), and eriococci Girault (California); the Australian species is immaturus Perkins (Queensland). The genus is therefore represented

between the parallels of about 52° north latitude and that of about 25° south latitude. The North American species are confined to the Lower Austral faunal region.

HISTORY OF THE GENUS.

The genus Alaptus was designated by a MS. note of A. H. Haliday's, published in Westwood's (1840) Synopsis of the Genera of British Insects, p. 79, and Walker's species, minimus, was named as type. The original description of the genus is as follows: "Tarsi pentamerous; antennae ♂ 10-jointed, filiform, 8-jointed ♀, last joint enlarged." The genus has subsequently been wrongly referred to Walker (1846) who gives a brief synoptic description of it. At this time, I do not believe that any further characteristics of the genus can be given, excepting the following, which may or may not be characteristic of this genus alone: Ocelli three in number, in a triangle on the vertex; antennae inserted below the middle of the face, unlike in the sexes; fore wings with very few discal cilia; the posterior margin near base, lobed, excised or dilated; hind wings maculate with dusky, usually smaller than the fore wings and more regular in shape; vertexal carina present: head about equal in width (dorsal aspect, natural position) to the greatest width of the thorax, the latter subequal to or slightly shorter than the abdomen; hypopygium plowshare-shaped, extending slightly beyond the abdomen; ovipositor not exserted; mandibles acute, scythe-shaped, minute (eriococci).

Family MYMARIDAE.
Subfamily GONATOCERINAE.
Tribe GONATOCERINI.
Genus Alaptus Haliday (Westwood, 1840.)
(Type—Alaptus minimus Walker.)

DESCRIPTION OF THE SPECIES.

1. **Alaptus minimus** Walker.

Westwood, 1840, p. 79.
Walker, 1846, p. 51.
Dalla Torre, 1898, p. 428.

"1. *minimus.* Ferruginosus antennis et pedibus pallidus."

It is impossible to recognize the species from this description, so that from specimens received from Washington, D. C., as hereinafter stated, I have drawn up the following description. The species was designated as the type of the genus in 1840, but was not described until six years later.

DESCRIPTION OF ALAPTUS MINIMUS WALKER.

Similar in general to the others.

Female: Scape long, slender, and curved, longer than pedicel and funicle 1 combined. Pedicel conical, stout, the margins convexly curved, wider than the scape, and thrice wider and nearly as long as the first funicle joint, its cephalic margin truncate, apparently serrate, widest at the base of the apical third and tapering proximad; the first three funicle joints slender cylindrical, the first and third subequal, but the third a little stouter than the first and second and a little longer than the first; the second one-fourth to one-third longer, the longest funicle joint , long and narrow; funicle 4 cylindrical oval, distinctly wider than 3 and shorter, subequal to 1, but a little shorter; funicle 5, subconical, the shortest and stoutest funicle joint, widest at the apex, the margins straight, a little over one-half the length of funicle joint 2, and shorter than the pedicel; club, the largest antennal joint, ovate, not exceeding the length of the 3 apical funicle joints combined, but twice wider than funicle joint 5. Setae as in the other species. (Fig. 1.)

FIG. 1. Antenna of Alaptus minimus Walker, greatly enlarged. Female.

Fore wings with two rows of discal cilia along the whole of the costal margin, one of the rows sometimes obscured. Hind wings with a single long row of the same, nearer the caudal margin. (From 2 specimens. 2-3 inch obj. Bausch & Lomb.)

Male—Same as female.

Antennae filiform; scape shorter, not exceeding the length of the pedicel and funicle 1; pedicel the same; funicle joints not so slender, cylindrical; 1 the shortest, subequal to 7; 2 and 3 subequal, 2 longer, however; 1, 2 and 3 equal in width; 4, 5, 6 and 7 gradually thickening, cylindrical oval, one-fourth to one-third wider than the three proximal joints; 4, 5 and 6 subequal in length, 4 longer, however, subequal to 2; 2 and 4 the longest funicle joints; 7 one-fourth shorter than 6; the club ovate, one-third shorter than 7, and sub-equal in length to the pedicel; as thick as funicle 7. (From 2 specimens. 2-3 inch objective, Bausch & Lomb.)

Redescribed from 2 males and 2 females, beautifully mounted in balsam by Mr. Frederick Enock of London, and comprising specimens determined by an English authority and in the collection of Dr. L. O. Howard, by whom they were loaned to the author.

The antennae of the male of minimus are very distinct from those of the male of iceryae but somewhat similar to those of caecilii, from which they differ in the fact that the funicle joint 1 is not much shorter than funicle 7 and that 2 and 4 are distinctly the longest funicle joints; from those of the male eriococci they are very distinct, the funicle joints in the latter being much shorter, the first three not long and slender, but all round oval, conic, or ovate, and the apical joint is the longest funicle joint; in eriococci and iceryae males, the shape of the antennal joints are entirely different from those of minimus and caecilii.

The female antennae differ from those of female iceryae in being cylindrical at the proximal funicle joints, and entirely different structurally; from those of female caecilii, not very much, but in the latter funicle 3 is distinctly thickened, subovate, and the relative lengths of the joints are different; the club is also as long as the three distal funicle joints, or longer; besides, the colors of the insects are different; from female eriococci, in the fact that like iceryae, the joints are differently shaped.

2. **Alaptus fusculus** Walker.

Walker, 1846, p. 51.
Westwood, 1879, p. 79.
Dalla Torre, 1898, p. 428.
Ashmead, 1904, pp. 362, 365.

"2. *fusculus*. Praecedente major colore obscurior antennis longioribus? Vix revera species distincta.

These two seem to be only varieties of one species which is common on windows near London."

This description also is entirely inadequate, and as Walker observes, the species may be synonymic with minimus. I have no knowledge of the existence of valid specimens of it, and unless these exist, see no reason why the species should stand. Ashmead (1904) gives this species as the type of the genus and refers it to Haliday.

3. **Alaptus pallidicornis** Foerster.

Foerster, 1856, p. 120.
Westwood, 1879, p. 79.
Dalla Torre, 1898, p. 428.

"Das Genus Alaptus ————————; ————————; ————————. Von dieser Gattung habe ich eine neue Art, Alaptus pallidornis m. in hiesiger Gegend gefangen, sie ist kaum halb so lang wie Alaptus minimus und hat fast weisslichgelbe Fühler."

This description also is inadequate. I have retained the spelling of the specific name suggested by Westwood in 1879, and which was adopted by Dalla Torre in 1898, without explanation. This changing of specific names is useless and now without sanction unless the original is an obvious error, which I consider this to be.

4. **Alaptus fuscus** Foerster.

Foerster, 1861, p. XLIII.
Dalla Torre, 1885, p. 80.
Idem, 1898, p. 428.

"Alaptus Walk. 123. *fuscus* n. sp. ♀. Lg. 2-5 mm. Schwarz, Schaft auf der Unterseite, Spitze der Schenkel, Basis und Spitze der Schienen sowie die Tarsen gelb; Endglied der Fühler sehr gross und dick, so lang wie die halbe Geissel." Habitat: Helvetia.

This description also is inadequate for recognition of the species.

5. **Alaptus excisus** Westwood.

Westwood, 1879, p. 586.
Riley and Howard, 1893, p. 267.
Dalla Torre, 1898, p. 428.

"I am indebted to Mr. Whitmarch, of Wilton, near Salisbury, for an opportunity of examining a very large number of glass slides, prepared for the microscope, containing minute insects mounted in Canada balsam—an excellent plan for the examination of such objects, so far as the observation of the general outline and of detached parts are concerned, the gummy solution rendering the parts more or less transparent. Amongst these specimens I found two insects belonging to the Mymarides, which I have no hesitation in regarding as the male and female of the same species. Both specimens had been reared from white blotches on oak leaves, evidently caused by the action of the minute larva of one of the leaf-mining Tineae (Lithocolletes?). The blotches were about 1¼ in. in diameter. The leaves were gathered on the 9th of September, 1871; and the little Mymars appeared on the 6th of October; one of the moths appeared on the 16th of September, 1871, and two other kinds of parasitic flies on the 4th of October following.

The action of the Canada balsam has destroyed the colors of the insects; so that the following description is confined to structural characters; moreover the male insect has unfortunately been fixed by the Canada balsam on its side, and the exceedingly minute size of the creatures rendered any attempt at displaying them, by arranging the limbs in the usual manner, ineffectual.

The head in the male is of large size and of an oval form (seen laterally), transverse in the female and widest behind; in this sex it appears to be furnished with two large appendages, truncate at the tips, which may possibly be dilated palpi. The antennae of the male are long and filiform, 10-jointed, the basal joint being the largest, the remaining nine being nearly equal in size. The antennae of the female are 8-jointed, the first joint large, the second smaller, the third considerably shorter and thinner than the preceding, the fourth to the seventh gradually but slightly thickened, and the eighth forming an elongated oval mass. The details of the thoracic segments are not easily determined, owing to the mode of preservation of the specimens; but the scutellum seems to be of large size and semicircular. The abdomen is sessile, depressed, and gradually pointed to the tip in the female, whilst it is more ovate in the other sex, with the male organ protruded. The wings are of equal size and shape in both sexes, the posterior ones being as large as the anterior, which latter have a remarkable dilatation near the base of the posterior margin*, terminating in an acute notch; the remainder of the margins of all the wings is fringed with long hairs; the legs are long, slender, and terminated by 5-jointed tarsi with large pulvilli.

The 5-jointed tarsi, the number of joints in the antennae of the two sexes, the sessile abdomen, and the very long narrow wings, agree with the characters of Haliday's genus Alaptus given by Walker in the "Annals of Natural History", Vol. XVIII (1846) p. 50. Of this genus two or, more probably, only one species is recorded in this country, namely *A. minimus*, "ferruginosus, antennis et pedibus pallidis"; the supposed second species, *A. fusculus*, "Praecedente major colore obscurior antennis longioribus, vix revera species distincta". (op. cit. p. 51). Another species, A. pallidornis (?pallidicornis), is slightly described by Foerster, found near Aix la Chapelle. It is scarcely half as long as A. minimus, with yellowish-white antennae (Hym. Stud. II, p. 120). As these authors do not mention the singular dilated and excised base of the forewings,† I consider the one before us distinct, to which may be applied the name of *Alaptus excisus*.

A. antennis maris corpore paullo longioribus, feminae corpori aequalibus; alis anticis basi postice dilatatis et subito excisis. Insecta minutissima. Long. circ. 1-6 mill.

* This dilatation is present at least in the females of iceryae Riley, and both sexes of caecilii Girault and eriococci Girault, and those of minimus Walker, so that the character is generic and not specific; to a less extent, it occurs in other genera. It is particularly strong in minimus.

† Compare the previous footnote in regard to this.

This species is founded on a generic character; it may or may not be synonymic with minimus Walker. The description is generic rather than specific and is inadequate for recognition of the species. The description of the antennae of the female, however, does not agree with minimus.

6. **Alaptus pallipes** Ashmead.

Ashmead, 1887, p. 193.
"112(1). Alaptus pallipes, n. sp.

Female. Length .02 inch. Black. Head very large, much broader than the rather slender thorax. Antennae 8-jointed, brown; scape short, dilated, pedical small, first funicle joint shorter than second, second longer, third short but thicker than second, fourth much longer and thicker than third, fifth still longer but not so thick, club greatly swollen, as long as the scape. Abdomen sessile, ovate, not as long as the thorax. Legs pale. Wings hyaline, with very long ciliae, the forewings spatulate, the hindwings linear.

Hab.—Florida." Type: One female in collection U. S. National Museum, Washington, D. C.

This is the first species of the genus to be described from North America. It is not listed by Dalla Torre (1898).

7. **Alaptus iceryae** Riley.

Riley, 1888, p. 130.
Idem, 1889, p. 86, Pl. XI, fig. 3.

This species has never been described. It was listed as "Alaptus iceryae n. sp." by Riley (1888) in Insect Life, in a list of parasites of the Fluted Scale in California, and again mentioned as such in the Report of the Commissioner of Agriculture for 1888 (Riley, 1889), where the female was figured, together with the details of the male antenna.

In a collection of slide-mounted Mymaridae loaned to me by Dr. L. O. Howard, I found four slides (3 ♂, 1 ♀) labelled "iceryae" most probably the original reared material from which Riley named the species. In addition to this , four more slides (bearing 3 ♂'s, 1 ♀) were found which bore the label, "Bred from male pupa of Icerya purchasi", and two slides (1 ♂, 1 ♀) marked "N. G. Mymarinae," bearing the same record and date, were found to be identical with the others. From this material I have thought it wise to draw up a description and to designate types.

Female:—Length 0.654 mm.; wing expanse, excluding cilia, 1.56 mm.; length of fore wing 0.691 mm., width of fore wing 0.45 mm. Minute in size.

Similar to eriococci Girault, but lighter in color, and slightly larger. The fore wings apparently with but a single discal seta situated about at the middle of the apical third of the wing.

Antennal structures dissimilar from those of eriococci, most noticeable in the relative lengths of funicle joints 1 and 2; in eriococci the first funicle joint is distinctly longer than wide and one-third shorter than the cylindrical joint following; in iceryae the first funicle joint is very slightly longer than wide and nearly as long as the cylindrical oval second joint of the funicle; the second

funicle joint in eriococci is distinctly twice longer than wide; in iceryae it is not more than one-third longer than wide, and sub-oval in shape, not cylindrical; in iceryae, funicle joints 1 and 2 are subequal; also in eriococci, funicle joint 2 is at least subequal to, or longer than, the third funicle joint, whereas in iceryae, funicle joint 2 is distinctly shorter than funicle 3.

Scape and pedicel normal, nearly as in eriococci; pedicel shorter and somewhat stouter, equal to, or slightly longer than the combined length of the first two funicle joints; funicle joints 1 and 2 abruptly smaller, subequal, funicle joint 1 subquadrate, joint 2 cylindrical oval; the latter about one-fourth longer. Funicle joints gradually enlarging to the club; funicle 3, elliptical oval, about one-third longer than the preceding joint, and wider; joints 4 and 5 of the funicle subequal in length to joint 3, each wider than the other, joint 4 regularly oval and joint 5 roundish ovate; funicle joints 3, 4, and 5 widest at the apical third, and none are as long as the pedicel or as wide; club regularly ovate, more regular than in eriococci. Setae the same, the basal row on the 3 apical funicle joints, however, apparently absent (high power), the apical row more distinct than in eriococci. (From 3 specimens, 2-3 inch objective, Bausch & Lomb.)

Male:—Length 0.691 mm.; wing expanse, excluding cilia, 1.45 mm.; length of fore wing 0.58 mm.; width of fore wing 0.45 mm.;

The same. Resembles very closely the male of eriococci, but is lighter in color, and slightly larger. However, at once distinguished by antennal characters. The second joint of the funicle smallest, very slightly more than half the length of the first funicle joint. This character is not present in the males of eriococci, and the less similar caecilii and minimus.

Scape and pedicel the same, the latter subequal in length to the two following funicle joints combined; funicle joint 1 suboval, distinctly longer than funicle 2, and shorter than funicle 3; funicle 2 subquadrate, about a third of the length of the next joint; funicle 3 thicker, ovate, nearly as long as the combined length of the two preceding joints, but about one-third shorter than the next joint, subequal in length to the pedicel; funicle joints 3–7 gradually widening to club; funicles 4–7 subequal in length, longitudinally carinate, the three apical joints with two distinct rows of setae at basal and apical third respectively, the basal row less distinct on funicle 4; funicles 4–7 slightly more thick at their apical third or fourth, all about one-third longer than the club joint, and thicker. The club or distal joint normal, conical, the base however rounded, and subequal in length to the pedicel, or slightly longer, less distinctly carinated. The club bears from 3 to 4 rows of sparse long setae, the three proximal funicle joints one each distad (in the middle of the basal funicle joint); and funicles 3–7 acute at their apico-lateral angles (high power). (From 7 specimens, 2-3 inch objective, Bausch & Lomb.)

Described from 7 males, and 3 females, mounted in balsam and received for study from Dr. L. O. Howard. These specimens were labelled as follows: "Bred from male pupa of Icerya purchasi. (Coquillett.)", 6 males, 3 females, bearing dates of May 24, July 19 and 23, August 4, 17, 22 and 25, and October 4, 1887; and "Bred from Aspidiotus convexus, November 28, 1887", 1 male. The species was therefore reared by Mr. D. W. Coquillett in California from the male pupae of Icerya purchasi Maskell and from some stage of the Greedy Scale, Aspidiotus rapax Comstock. The second species of the genus to be described from North America, Alaptus pallipes Ashmead being the first.

TYPES:—No. 11938, U. S. National Museum, Washington, D. C., 3 ♂, 1 ♀ (the 4 slides originally labelled iceryae.) Cotype, Accession No. 37489, Illinois State Laboratory of Natural History, Urbana, Illinois, 1 male, 1 female (2 slides).

This species was also overlooked by Dalla Torre (1898).

8. **Alaptus immaturus** Perkins.

Perkins. 1905. p. 197.

"Alaptus, Hal.

Antennae of female 8-jointed, the scale elongate, the second joint dilated and much wider than the following, third slender, elongate, rather shorter than the fourth, 5th, 6th, and 7th, increasing in width, club nearly as long as the four preceding. Antennae of male 10-jointed, the scape elongate, second wider than the following, third elongate, but shorter than the fourth, which is subequal to the following joints. Posterior ocelli close to the eye-margins, the three forming a triangle with extremely wide base. Tarsi 5-jointed. Abdomen sessile. (Plate XII, fig. 5; antennae of female in two aspects, and that of the male.)

Alaptus immaturus, sp. nov.

Female: Pallid ochreous, the head sordid and also the thorax along its posterior margin; abdominal segments with obscure, sub-quadrate, lateral, blackish or sordid spots. Antennae with two basal joints pale, the rest dark. Length 3-8 mm.

Hab.: Bundaberg, Queensland, bred from cane leaves containing leafhopper eggs, but I do not feel sure that it is parasitic on these."

The descriptive portion under the generic heading refers to the species, but the arrangement is unfortunate; the description lacks many details which could just as well have been given.

9. **Alaptus globosicornis** species nova.

Female: Length, 0.1999 mm; wing expanse, excluding cilia, 0.58 mm.; width of fore wings, 0.0273 mm.; length of fore wings, 0.23 mm. Very minute.

General color uniformly pale brown; the legs, excluding the intermediate and posterior tarsi, paler; eyes and ocelli red; margins of the fore wings yellowish brown. Body impunctate, smooth. Fore wings normal, discal cilia entirely absent excepting two distinct solitary ones in a line in the middle of the base of the distal third of the wings: marginal cilia abruptly increasing in length on the posterior margin at the distal fifth of the wing; the distal cilia largest, at least 2 1-2 times as long as the greatest width of the fore wing; fore wings spatulate, gradually widening just beyond the basal third which is linear, and widest at distal fifth, the apex narrowly rounded; one margin slightly concaved at distal fifth; distal cilia transparent a short distance beyond their insertion, forming a distinct white path a slight distance from the margin of the wing and following the outline of the distal part of the wing. Hind wings mottled with dusky, without discal cilia, clavate, a short row of cilia near the margin in the wing surface (high power). Body, including antennae and legs, bearing scattered setae. The vertexal carina present, apparently as in caecilii. Thorax and abdomen about equal in length.

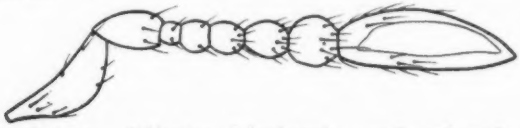

FIG. 2. Antenna of Alaptus globosicornis, greatly enlarged. Female.

From 2 specimens. 2-3 inch objective. Bausch & Lomb.

Male:—Unknown.

Barely visible to the naked eye when held to the light.

Legs normal, the anterior tibial spurs long, slender and curved; apparently two, but if not, then one forked beyond the basal half.

Antennae pale brown, concolorous with body, the funicle, however, very slightly dusky. Scape, pedicel, and club bearing sparse, scattered, setae; the funicle joints delicately subverticellate, each with two more or less regular

whorls of uneven setae on the apical half (high power). Scape convexly curved, about as long as the next four joints combined; pedicel subconic, as broad as the scape, narrower than club, and as long as the next two joints combined; funicle moniliform, each joint globular, funicle 1 abruptly smaller than the pedicle, and slightly smaller than funicle 2; funicle joints 2 and 3 subequal, funicle 3 slightly larger, both somewhat larger than funicle 1; funicle joints 4 and 5 each increasing somewhat in size; funicle joint 5 at least twice larger than funicle joints 2 and 3, and 1-3 larger than funicle 4; club undivided, abruptly larger than the funicle and cylindrical oval in shape; it is from 1-3 to 1-2 wider than either the scape or pedicel, and as long as the 4 apical funicle joints combined; club bearing a few scattered setae, a little more numerous at base. (Fig. 2.)

Described from two females mounted in balsam, received for determination from Dr. L. O. Howard, Chief of the Bureau of Entomology, U. S. Department of Agriculture, Washington, D. C., and labelled as follows: "Morrill No. 2008, Bred from Purple scale, VIII, 10. 1907. E. A. Back." Therefore reared from Lepidosaphes beckii (Newman), the Purple scale, Orlando, Florida. Stage of host not indicated.

TYPE: No. 11858, U. S. National Museum, Washington, D. C., 2 females.

The characteristic of this species is the moniliform funicle of the antennae, quite unlike in structure that of any other species of the genus now known.

10. **Alaptus caecilii** species nova.

Female:—Length 0.327 mm.; wing expanse, excluding cilia, 0.909 mm.; width of fore wings, 0.0546 mm.; length of fore wings, 0.399 mm. Minute.

General color uniformly bright lemon yellow. Eyes and ocelli red, legs uniformly pale yellowish, venation and margins of the fore wings dusky yellow; head slightly darker. Body normal, bearing scattered setae, apparently smooth. Vertexal carina present, running across the cephalic margin of the vertex between the eyes, and on each side back (caudad) around the inner margin of the eye, over the apex of the eye, touching the lateral ocellus, around to the (outer) caudo-lateral aspect of the eye; the part following the margin of the eye is alternately dark and pallid as though consisting of small varicolored segments, while the transverse part is solid or with larger alternate segment-like colorations, or pale laterad. After rounding the apex the carina is not so close to the apical (caudal) eye margin. Eyes subcordate in shape, moderately coarse, naked. Ocelli in a triangle on the caudal part of the vertex; apparently red and yellow, or particolored, the lateral ocelli touching the occipital margin, and the distance between them and the eyes is twice greater than that between either and the margin of the eye. Median line of thorax pale, grooved; parapsidal furrows apparently absent, at least inconspicuous. Ovipositor slightly exserted.

Wings normal, as in globosicornis but larger, the fore wings margined with dusky yellowish, the discal cilia entirely absent with the exception of a single short middle row consisting of from 3 to 6 cilia. Hind wings mottled with dusky, as in globosicornis; the row of cilia near the margin of the wing surface, guarding the marginal cilia, longer and stronger (high power). Legs normal; anterior tibial spurs long, slender and curved; the others minute; as in globosicornis.

Antennae concolorous with body. Scape short, one margin nearly straight, the other regularly convex, about one-third longer than the pedicel, and as thick in the middle; pedicel ovate, the distal end truncate, however; thicker by 2 times and somewhat longer than the first funicle joint; funicle joint 1 cylindrical slender, one-third shorter than the pedicel and funicle 2; the latter equal in width

to the preceding joint, but one-third longer, subequal in length to the pedicel, and nearly a third larger than funicle 3; funicle joint 3 shorter, equal in length to funicle, 1, or somewhat longer, and cylindrical oval, therefore somewhat thicker than the preceding funicle joints; funicle gradually thickening from the third joint to club; funicle joints 4 and 5 subequal in length and width, oval, thicker than the joint immediately preceding but somewhat shorter, nearly equal in length to funicle joint 1; funicle joint 4 very slightly longer than joint 5 of the funicle, the latter not as large as in the figure. Club undivided, abruptly longer and broader, with 2 paler furrows visible from one side; it is as long as the three preceding joints combined, and about twice the length of the scape, and ovate in shape the base rounded, the apex tapering; club uniformly hairy. Antennae bearing rather sparse soft hairs beyond the second joint of the funicle, most numerous on the club, but sparser on funicle joints 1 and 2; scattered on the pedicel and scape; in general a single whorl on funicle joints 1 and 2, and 2 on joints 3–5 of the funicle, and more or less uniform on the club. (Fig. 3). (From 39 specimens. 2-3 inch objective Bausch & Lomb.

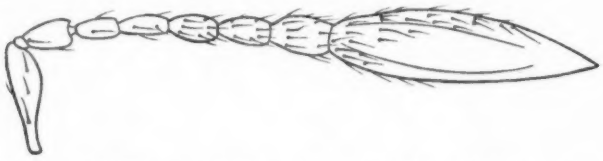

FIG. 3. Antenna of Alaptus caecilii, greatly enlarged. Female.

Male:—Length, 0.326 mm.; wing expanse, 0.873 mm.; width of fore wings, 0.455 mm.; length of fore wings 0.382 mm.

The same. Antennae 10-jointed, filiform; scape and pedicel the same, the first funicle joint, however, a little more than half the length of the pedicel, and the second funicle joint, or nearly two-thirds the length of the latter; funicle joint 3 a little longer than the second joint, funicle 4 about 1-4 longer, and thicker than funicle 3; funicles 4, 5, 6, and 7 subequal in length and shape, and truncate, slightly wider anteriorly and bearing a thicker seta from each apical corner; preceding joints cylindrical; club or apical joint conical, shorter than the preceding funicle joint. Antennae thickening uniformly beyond the third funicle joint; flagellum, excluding the scape, apparently longitudinally striate; clothing as in female, the hairs slightly more sparse in the male. (From 2 specimens. 2-3 inch objective, Bausch & Lomb.

Described from two males and thirty-nine females mounted in balsam. The species is larger than globosicornis, lighter in color, and the antennae entirely different structurally. Otherwise they are superficially alike. I have before me the following specimens kindly transmitted by Dr. L. O. Howard: Six slides marked: "Morrill No. 2009. Bred from Psocid eggs, Orlando, Fla., VIII, 5, 1907. E. A. Back" (3 slides, 14 females); "Morrill No. 2002. Hymenopterous parasites of eggs of psocids (1005) on orange leaves. 1 specimen bred; 1 specimen taken on leaf near eggs. A. W. Morrill, 2.13–1907. (See Morrill No. 2009)", (1 slide, 2 females); and "Morrill No. 505. Hymenopterous parasite from breeding box containing Spiræa leaves infested by Aleyrodes fernaldi Morl., from Amherst, Massachusetts. 9–20–1906", (2

slides, 2 females). Five slides from the collection U. S. Department of Agriculture marked—"Alaptus sp. From eggs of Caecilius aurantiacus Hagen. Los Angeles, Cal., July 30, Aug. 15, 29, 1888. Coquillett." (5 slides, 1 male, 11 females). Four slides from the same collection marked as follows: "From eggs of Psocus, July 13, 15, 17, 21, 1888. Coquillett." (4 slides, 1 male, 10 females). The males were reared June 30 and July 21, 1888.

This species is therefore parasitic on the eggs of Caecilius aurantiacus Hagen at least, and is found in both California and Florida; I am inclined to think the record from Aleyrodes fernaldi Morl. as due to accidental presence of the parasites, and perhaps their host, in the breeding box containing the Aleyrodid, though it is quite within the range of possibility that they are parasitic on it. I think this not the more probable, however, especially in view of the fact that the host was from the north.

This species is undoubtedly the one referred to by Howard (1894). Habitat: Florida; California; ? Massachusetts.

TYPE: No. 11859, U. S. National Museum, Washington, D. C., many balsam specimens, ♂ ♀; Cotypes, Accession No. 37491, Illinois State Laboratory of Natural History, Urbana, Illinois, 2 ♂, 5 ♀, in balsam; and Cotype No. $\frac{1905}{26151}$, Milwaukee Public Museum, 3 females, balsam specimens.

11. **Alaptus eriococci** species nova.

Female:—Length 0.618 mm,; wing expanse, excluding cilia, 1.44 mm.; width of fore wing 0.394 mm.; length of fore wings, 0.618 mm. Minute in size.

General color uniformly dusky brown, distinctly darker but very similar to iceryae Riley. Eyes dark red, ocelli red and yellow, in a curved line in the middle of the vertex. The lateral ocelli not touching the occipital margin; antennae, legs, and margins of the wings concolorous, or slightly paler. Vertexal carina present, similar to that in caecilii. Body impunctate, with a few scattered setae.

Wings normal, nearly regularly spatulate, little or no curve at the apical fifth; a single short row of 3–4 discal cilia beginning at the apical half of the wing. Hind wings spatulate marked as in the preceding species.

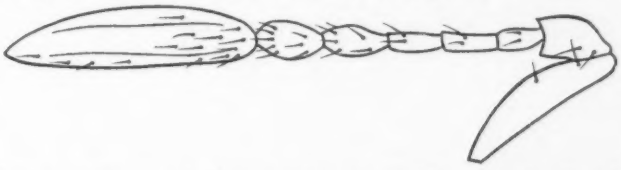

FIG. 4. Antenna of Alaptus eriococci, greatly enlarged. Female.

Antennae somewhat similar to those of iceryae, but they increase in size less regularly; distinct from those of globosicornis and caecilii. Scape more uniform, not increasing much in width at the middle but rather slender and regularly convex, nearly as long as the next four joints combined; pedicel at

most one-third the length of the scape, longer than wide, subcuneate in shape, wider than the scape and much more so than the following joint, about two-thirds the width of the club, and slightly shorter than the combined length of the first two funicle joints; funicle joint 1 the smallest joint, longer than wide, one-third shorter than funicle joint 2; the latter cylindrical, twice longer than wide, subequal to or slightly longer than funicle joint 3 which is inclined to be a little thicker and shorter; joints 4 and 5 of the funicle suboval, joint 4 one-third wider than funicle 3, and one-third narrower than funicle 5, and about subequal in length to funicle joints 2 and 3; the apical joint of the funicle more round, and slightly shorter; club normal, not as long as the combined length of the four preceding joints, but longer than that of the three preceding joints; subequal in length to the scape but twice wider, or nearly so. Setae on antennae as in caecilii. (Fig. 4). (From 11 specimens, 2-3 inch objective, Bausch & Lomb.)

Male:—Length, 0.620 mm.; wing expanse, excluding cilia, 1.44 mm.; width of fore wings, 0.394 mm.; length of fore wings, 0.618 mm.

The same, more slender. Antennae 10-jointed, filiform, longitudinally striate, more finely so in the pedicel; dissimilar from those of caecilii and iceryae, the shape of the segments more similar to the latter species; in eriococci the first funicle joint is the shortest, about half the length of the pedicel, but in iceryae the second funicle joint is distinctly the smallest, about, or slightly less, than half of the pedicel, while in caecilii the first funicle joint is the smallest and more than half the length of the pedicel.

Scape and pedicel as in the female; first funicle joint globose, not two-thirds the length of the following joint (funicle 2) which is cylindrical, longer than wide and subcuneate in shape; funicle joints 2 and 3 subequal; joints 4, 5, 6, and 7 subequal, wider and one-fourth longer than the joints 2 and 3, more hairy and slightly more rounded; apical or club joint pointed ovate, rounded at base and tapering somewhat to tip from the middle, narrower than joints 4–7 of funicle but subequal in length; joints 2–7 truncate apically, and widening very slightly from the 4th joint, the apical angles acute. Setae as in the female; single rows on joints 1 and 2 of funicle, on joint 3 a second row represented sometimes, and on joints 4–7 two distinct rows in the middle respectively of the proximal and apical halves of the segments. (Fig. 5.) (From 25 specimens. 2-3 inch objective, Bausch & Lomb.)

FIG. 5. Antenna of Alaptus eriococci, greatly enlarged. Male.

Described from 25 males and 11 females mounted in balsam, received for study from Dr. L. O. Howard, Chief of the National Bureau of Entomology, and forming a part of their Collection of Mymaridae. The specimens were labelled as follows: "Bred from Rhizococcus araucariae. August 29, 30, 1887 (5 ♂, 4 ♀), and September 1–5, 1887, (19 ♂, 7 ♀)", and "Bred from Aspidiotus aurantii (San Gabriel Valley), Los Angeles, California, Sept. 9, 1887 (1 ♂)." Therefore reared from Eriococcus araucariae Maskell and the Red Scale of California, Chrysomphalus aurantii (Maskell). Habitat: Los Angeles, California.

TYPES: Type No. 11937, U. S. National Museum, Washington, D. C., 16 males, 5 females, (3 slides). Cotypes: Accession No. 37490, Illinois State Laboratory of Natural History, Urbana, Illinois, 3 males, 3 females.

This species is very similar to Alaptus iceryae Riley females, but the males are distinct. The females of the two species may, however, be distinguished by the dissimilar antennal structures.

TABLE OF SPECIES.

This table includes those species only which have been accessible to me or have been described sufficiently well to enable diagnostic characters to be selected.

FEMALES.

A. Species yellow.
Club joint as long as the 3 apical funicle joints combined, the latter oval, the 2 proximal funicle joints cylindrical, funicle 1, one-third shorter than funicle 2; fore wings with 4–5 discal cilia. **caecilii**

B. Species brown, or yellowish brown.
1. Proximal funicle joints cylindrical, slender, longer than the apicals. Club joint not as long as the 3 apical funicle joints combined; the 2 apical funicle joints oval, the 3 proximal ones cylindrical, slender; funicle 2 the longest joint of the funicle, funicle 5 shortest, subequal to 1; fore wings with 2 long rows of discal cilia near the costal edge, one of which is often obscured; no cilia in the disk or center of wing..... **minimus**
2. Proximal funicle joints short, subquadrate, rectangular, ovate or conic; not cylindrical and slender, or much longer than the 2 apical joints; club equal in length to the 3 apical funicle joints, or longer.
a. Dark brown; proximal funicle joints rectangular, the 2 apical funicle joints unequal, funicle 5 globose, much larger than funicle 1—the shortest funicle joint; funicle 2 twice the length of funicle 1 and the longest of the 3 proximal funicle joints; fore wings with 2 discal cilia..... **eriococci**
b. Light brown; proximal funicle joints quadrate, the 2 apical joints subequal, funicle 2 but one-third longer than funicle 1, and intermediate in size of the three proximal funicle joints; fore wings with a single discal cilium..... **iceryae**
3. Joints of funicle globose, the funicle moniliform, funicle joints 2 and 3 subequal, club equal in length to the 4 apical funicle joints; wings with but 2 discal setae..... **globosicornis**

C. Species black.
Proximal funicle joints unequal, the second longer, the 4th and 5th joints much longer than the third joint..... **pallipes**

MALES.

A. Species yellow.
Antennal joints subequal in length, the club and funicle 1 shortest; fore wings with 4–5 discal cilia..... **caecilii**

B. Species brown, or yellowish brown.
1. Proximal segments of funicle cylindrical, slender, much longer than wide. Antennal joints subequal in length, slender, the club and funicle 1 shortest, excepting perhaps the pedicel, funicle joints 2 and 4 longest of the flagellum; fore wings with 2 rows of discal cilia along the costal margin..... **minimus**

2. Proximal segments of antennae short, ovate or quadrate, not much longer than wide.
   a. Dark brown; flagellar joints uniform, gradually increasing in size, funicle 1 shortest, globose; funicle joints 2 and 3 subequal; fore wings with 2 discal cilia. **eriococci**
   b. Light brown; flagellar joints uniform, gradually increasing in size, funicle 2 shortest, about one-third the length of 3; funicles 1 and 3 unequal; fore wings with a single discal cilium..... **iceryae**

LITERATURE REFERRED TO.

1840. Westwood, John Obadiah. Synopsis of the genera of British insects. Introduction Modern Classification of Insects: etc., London. II, p. 79.

1846. Walker, Francis. Annals and Magazine of Natural History, London, XVIII, p. 51.

1856. Foerster, Arnold. Hymenopterolgische Studien, Aachen, II, p. 120.

1861. Foerster, Arnold. Progr. Realsch, Aachen, p. XLIII.

1879. Westwood, John Obadiah. Trans. Linnaean Soc. London, Zoology, I, p. 586, table 73, figs. 10, 11.

1885. Dalla Torre, Carl G. de. Jahresbericht Naturf. Ges. Graubunden. XXVIII, p. 80.

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1887. Cresson, Ezra Townsend. Synopsis Hymenoptera of America, North of Mexico. Trans. American Ent. Soc., Phila., Supplementary volume, 1887, pp. 85, 137, 250.

Alaptus Walker, 1846. On page 250, in the catalogue of the described Hymenoptera of American North of Mexico, under Alaptus is given Elaptus aleurodis Forbes, 1884, the only species listed. Elaptus aleurodis Forbes is not a mymarid, and is synonymic with Amitus aleurodinis Haldemann. Cf. Forbes (1885).

1888. Riley, Charles Valentine. Insect Life, United States Department of Agriculture, Division of Entomology, Washington, D. C., I, p. 130.

1889. Idem. Report of the Entomologist, in Report of the Commissioner of Agriculture, 1888. United States Department of Agriculture, Washington, D. C., p. 89, pl. XI, fig. 3.

1893. Riley, Charles Valentine and **Leland Ossian Howard.** The smallest insect known to Entomologists. Insect Life, United States Department of Agriculture, Division of Entomology, Washington. D. C., V, p. 267. (Howard, Standard Natural History, Kingsley, Boston, II, p. 512.)

Brief note in answer to correspondent. Alaptus excisus Westwood the smallest insect known to date, being but .17 mm. long. Probably parasitic on the eggs of a coccid.

1894. Howard, Leland Ossian. The Hymenopterous parasites of the California Red Scale. Insect Life, United States Department of Agriculture, Division of Entomology, Washington, D. C., VI, p. 228.

Alaptus sp., evidently caecilii Girault, reared by Coquillett in 1887 or 1888 at Los Angeles, California, from orange leaves infested with the "Yellow Scale" and therefore at first thought to be parasitic on that insect; afterwards reared in large numbers from the eggs of Caecilius aurantiacus Hagen and is therefore most probably not a coccid parasite, the true host eggs being overlooked in the first rearings.

1904. Ashmead, William Harris. Classification of the Chalcid flies of the superfamily Chalcidoidea, etc. Memoirs Carnegie Museum, Pittsburgh, pp. 362, 365.

Alaptus Haliday; type given as fusculus Haliday.

1905. Perkins, R. C. L. Bull. No. 1, Part 6, Division of Entomology, Hawaiian Sugar Planters' Association, Honolulu, p. 197. (Report of Work of the Experiment Station of the Hawaiian Sugar Planters' Association.)

ACKNOWLEDGMENTS.

It gives me pleasure to acknowledge the kind assistance of Dr. Henry Skinner, of the Academy of Natural Sciences, Philadelphia, Pa.; that of Mr. C. R. Crosby, of Cornell University, Department of Entomology; and that of Mr. Charles T. Brues, Curator of Invertebrate Zoology, Milwaukee Public Museum. I wish to thank these gentlemen especially for furnishing abstracts of the literature.

I am particularly indebted to Dr. L. O. Howard, Chief of the Bureau of Entomology, U. S. Department of Agriculture, for the specimens upon which the descriptions in this paper are based, and for the opportunity of studying a large series of European Mymaridae, besides many other kindnesses.

For the figure of the antenna of Alaptus minimus Walker, I am indebted to Mr. J. D. Hood, of the University of Illinois; and for redrawings of the others from camera lucida tracings, to Mr. William D. Matthews, formerly of this office.

THE INTERNAL ORGANS OF REPRODUCTION OF THE MALE SAW-FLY, CIMBEX AMERICANA LEACH.

HENRY H. P. SEVERIN and HARRY C. M. SEVERIN.

(WITH PLATE XII.)

HISTORICAL.

The male organs of reproduction of various Hymenoptera have been the object of study of a number of naturalists. Swammerdam (35), Réaumur (25), Dufour (10), Leydig (21), Leuckart* and more recently Cheshire (6), Koschewnikoff (20), Bordas (3), and Michaelis (22) have all worked on the reproductive organs of the drone bee. Schneider (31), in his general considerations upon the development of the reproductive organs of insects, has devoted some time to the Cynipidae and Ichneumonidae. Kluge (19) has worked on the male genital organs of Vespa germanica. Bordas (3) carried his research to several genera belonging to various families of Hymenoptera often not closely related. A number of other naturalists:—André (1), Schmiedeknecht (30), Hoffer (17), Radoszkowski (26, 27, 28), Verhoeff (37) and Zander (38, 39) have carried on their study on the external genital apparatus of various Hymenoptera.

A few authors have extended their investigations to different species of the family Tenthredinidae. Burmeister (32) figures and describes the external genital armature of Cimbex variabilis.

Dufour (10) described the anatomical relation of the reproductive organs of a number of species belonging to this family; viz., Cephus pygmaeus, Tenthredo cincta, Tethredo rustica, and Hylotoma enoides. In Cimbex he describes the large accessory glands or glandulae mucosae as vesiculae seminales. In all the figures of the various species of Tenthredinidae he has made this same mistake.

After Dufour, Leuckart has treated in a general way the male reproductive organs of Anthidium and Athalia. Bordas (3) quotes nearly in-extenso his work which we reproduce as follows:—"La structure des testicules consiste, chez les Anthidium, en une série de trois conduits séminifères qui se continuent par un canal déférent commun. Chez l'Athalia, ils sont constitués par une

*Paper not accessible

suite de poches arrondies. Les canaux déférents sont longs, grêles et s'entrelacent parfois pour former des testicules secondaires (Athalia). Les glandes accessoires, en forme de conduits terminés en cul-de-sac, s'insèrent à des hauteurs variables, le long des canaux déférents."

Raymond (29) in his work upon the organization of Nematus ribesii Scopoli has described, in a general way, the reproductive organs of this species. He writes, "Les vésicules séminales de ces insectes sont piriformes, au nombre de deux, et elles mesurent environ 1 millimètre de longueur; le canal déférent qui les surmonte est un tube court, s'anastomosant avec son voisin, après un faible parcours, pour former le canal éjaculateur qui s'ouvre entre les armatures sexuelles.

Près de leur partie postérieure et latéralement, chacune des vésicules porte un tube à parois transparentes et épaisses, ayant $0^{mm}07$ de diamètre. Ces tubes, que nous n'avons pu suivre jusqu'à leur extrémité, représentent les testicles et ont une certaine analogie avec les ovaires des femelles. Les vesicules ont des parois très épaises, vaguement fibreuses; elles sont très contractiles et contiennent un liquide laiteux chargé de globules arrondis et très petits. Malgré tous nos efforts, nous n'avons pu constater aucun mouvement propre à ces corpuscles."

A dissection of this species revealed to us that he has made the same mistake as Dufour, in calling the accessory glands or glandulae mucosae the seminal vesicles.

Packard (24) in his text book of entomology copied Newport's (23) figure of the male reproductive organs of the saw-fly, Athalia centifoliae but modified the description as follows:—

Newport's description.	*Packard's description.*
(a) The smaller testes.	a, a, testes.
(b) The duct.	b, b, epididymis.
(c) The large pair of testes. (d) The efferential vessel.	c, d, vas deferentia.
(e) The vesiculae seminales.	e, vesiculae seminales.
(f) The approximation of their ducts.	f, ductus ejaculatorius.
(g) Extremity of the penis.	
(h) Ejaculatory duct.	h, penis.

A comparative study of our work on Cimbex americana shows that the male reproductive organs are very similar to those of the saw-fly, Athalia centifoliae figured by Newport and copied by Packard. It appears to us that Packard in his revised explanation of Newport's figure has fallen in to the same error as Dufour,

calling the large accessory glands or glandulae mucosae, the vesiculae seminales. The vasa deferentia of Packard's explanation correspond to the vesiculae seminales of Cimbex and the epididymes to the vasa deferentia. Newport's description of the male reporductive organ of Athalia centifoliae is so far from correct that it is hardly worth consideration.

ANATOMICAL DESCRIPTION.

The male organs of reproduction of Cimbex americana consist of six principal parts:—the testes, the seminal ducts (vasa deferentia), the seminal vesicles, the accessory glands (glandulae mucosae), the ejaculatory ducts and the external genital armature.

The testes are paired (Fig. 1, t) and are situated on each side of the alimentary canal, in the sixth abdominal segment. They are kidney-shaped and are completely embedded in adipose tissue. When this adipose tissue is carefully dissected away, it is found that the testes are enveloped by a thin membrane ("capsule enveloppante" of Bordas (3)).

A number of tracheae originating from the fifth and sixth abdominal spiracles (Fig. 2, 5s and 6s) send off numerous branches which penetrate this membrane and hold the testes in their lateral position. One main trunk, which originates near the fifth abdominal stigma, gives off a number of branches to the anterior and of the testis (Fig. 2, tr); those tracheae which originate from the sixth abdominal spiracle send off, near the inner margin of the testis, numerous branches which divide and redivide, forming a network on the generative organ.

Each testis sends off from its inner median margin a very thin cylindrical tube, the vas deferens (Fig. 1, vd). Both vasa deferentia pass backward as straight tubes through the seventh abdominal segment and widen rather abruptly in the anterior region of the eighth segment to form the seminal vesicles. The seminal vesicles make several convolutions (Fig. 1, sv) and then communicate posteriorly with the large accessory glands (Fig. 1, o).

The aceessory glands or glandulae mucosae are a pair of hooked glands with the distal ends enlarged and rounded, while the posterior portion of each gradually narrows into a duct (Fig. 1, gm). The two glandulae mucosae diverge and are obliquely inclined on each side of the anterior region of the rectum. These glands partly conceal the last abdominal ganglion, which sends nerves to them.

From an external view one cannot say with certainty just where the ducts of the glandulae mucosae end and the ejaculatory ducts begin. The latter are two short cylindrical tubes which continue side by side and only join at their terminal extremity to open to the oustide. Zander (39) describes the ductus ejaculatorius of Cimbex variabilis as a "enges Rohr, das den Penis durchzieht."

HISTOLOGICAL DESCRIPTION.

Testis: A study of sections cut through the testis shows that the club-shaped testicular follicles are surrounded by a thin membrane ("capsule enveloppante" of Bordas) which contains small ovoid nuclei. Numerous tracheae penetrate this membrane and branch and rebranch in the space between the testicular follicles. A delicate network of loose fibrous connective tissue is present in the space between the testicular follicles.

The testicular follicles open into an enlarged portion of the distal end of the vas deferens, the so-called collecting reservoir, which is excentrically placed within the testis. Each testicular follicle does not always open separately into this collecting reservoir, but oftentimes two or more join with one another before opening into it.

A longitudinal section parallel to the surface of the testis shows that the epithelial layer of the collecting reservoir extends for a short distance into each testicular follicle. The epithelium consists of a layer of flattened cells, with cell boundaries indiscernible; each cell contains an ovoid nucleus. The epithelial cells rest upon a basement membrane. External to this membrane is a branching muscle layer, which continues for some distance on each testicular follicle. In our work upon the female reproductive organs of Cimbex (34) we found branching anastomosing muslces in the egg-tubes extending to the apex of the ovariole, being present in even the terminal filament.

Vas deferens: The vas deferens is made up of the following layers passing from without, inward:—1, a very much folded, peritoneal membrane; 2, a longitudinal branching muscle layer; 3, a muscle layer composed of transversely striated circular and oblique fibres; 4, a basement membrane and 5, an epithelial layer consisting of elongated cells with cell boundaries not discernible.

Seminal vesicle: With the exception of that region of the seminal vesicle, which is near the opening into the glandula muco-

sa, the histological structure is similar throughout its entire extent. The external peritoneal membrane covers a thin layer of longitudinal branching muscles. Within these are the circular muscles which often run obliquely. Next within, is a layer of epithelial cells with cell boundaries indiscernible, each cell containing an ovoid nucleus embedded in a granular protoplasm. The long axis of the nucleus is usually parallel with the free ends of the epithelial layer (Fig. 6, nep.) Within the lumen are bundles of spermatozoa which are embedded in a secretion.

Near the opening of the seminal vesicle into the glandula mucosa the structure of the former differs from that just described. The circular muscles are better developed, being from two to three layers in thickness. The cells gradually increase in size, cell boundaries are usually apparent and the nuclei assume a position at right angles to the free ends of the cells (Fig. 3, nc). These cells gradually pass over into the large cells of the glandula mucosa (Fig. 3, c.)

The openings of the seminal vesicles into the glandulae mucosae are directed posteriorly towards the ducts of these glands. On this account the sperms in passing from the seminal vesicles into the mucous glands probably never reach the distal end of the latter, but pass directly into the ducts of the glands and then into the ejaculatory ducts. In all our sections we did not find any sperms in the large swollen ends of the glandulae mucosae, a fact which supports the above view.

Accessory glands: A transverse section through the accessory glands shows that the epithelium is thrown into a number of large folds which almost fill the lumen (Fig. 3). The epithelial layer of the swollen distal part of the glands consists of exceedingly long cells with cell boundaries usually well defined (Fig. 4). Each cell contains a single ovoid nucleus with its long axis parallel to the same axis of the cell. The position of the nucleus varies within the cell; occasionally it is found near the free end, sometimes near the middle, but more often the nucleus is found near the basal region of the cell. These cells are glandular and contain numerous droplets of secretion (Fig. 4, g). The epithelium rests upon a thin basement membrane, outside of which are the muscle layers. Within the folds of the epithelial layer are branching muscles which are not so well developed as the external circular muscles. External to the circular muscles is a very thin delicate peritoneal membrane.

The glandular nature of the epithelial cells is shown by the presence of secretory processes which are somewhat similar to those that we have described and figured in the mid-intestine of Cimbex (33). Bordas (4) in his investigation upon the male reproductive organs of Coleoptera has described secretory processes in the accessory glands of a species of Lucanus and Dorcus parallelipipedus. In the process of secretion of Cimbex the free end of the cell becomes swollen causing it to project above the glandular cells at rest (Fig. 4, gl). The swollen mass elongates and assumes a more or less pyriform shape (Fig. 5, A). Further stages can be found in which the globules are still in direct continuity with the protoplasm of the cell, from which they originated, by a fine pedicel. Finally the globule becomes free by strangulation and floats in the lumen of the glandula mucosa (Fig. 5, B).

Since Zander (39) who has worked on the morphology of the male genital apparatus of various Hymenoptera, has described the ejaculatory ducts and penis of Cimbex variabilis, we made no further attempt to examine these parts in Cimbex americana.

We are deeply indebted to Prof. Wm. S. Marshall for the use of literature which was borrowed from his excellent entomological library.

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EXPLANATION OF PLATE XII.

All figures were drawn with a camera lucida.

FIG. 1. Dorsal view of reproductive organs: *t*, testis; *vd*, vas deferens; *sv*, seminal vesicle; *o*, entrance of seminal vesicle into glandula mucosa; *gm*, glandula mucosa; *ed*, ejaculatory duct. (X 16).

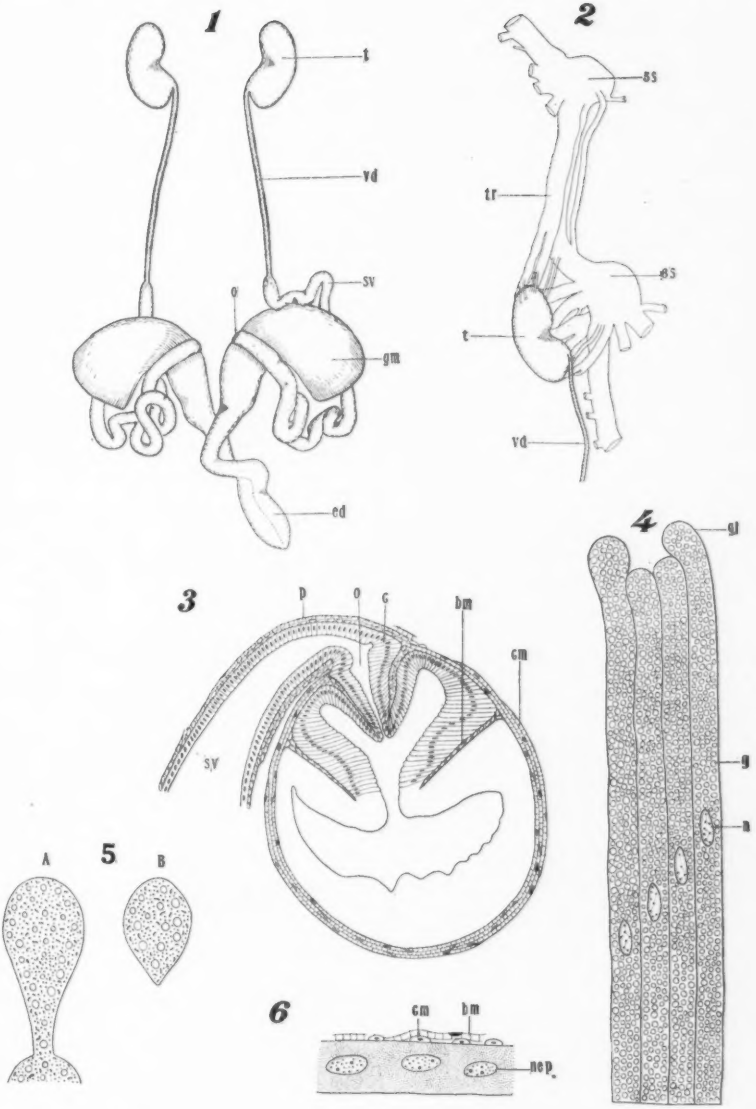
FIG. 2. Tracheae which hold the testis in its lateral position in the abdomen: *5s*, fifth abdominal stigma; *6s*, sixth abdominal spiracle; *tr*, trachea, which gives off a number of branches to the anterior end of the testis; *t*, testis; *vd*, vas deferens. (X17).

FIG. 3. Section through seminal vesicle and glandula mucosa, showing the opening of the former into the latter: *nc*, nuclei changing their direction; *sv*, seminal vesicle; *p*, peritoneal membrane; *o*, opening of the seminal vesicle into the glandula mucosa; *c*, cellular change; *bm*, branching muscles within the folds; *cm*, circular muscles. (X60).

FIG. 4. Exceedingly long cells of glandula mucosa: *gl*, swollen end of cell in the early process of forming a secretory globule; *g*, droplet of secretion; *n*, nucleus. (X650).

FIG. 5. Secretory processes: A, pyriform secretory process in direct continuity with the protoplasm of the cell from which it has originated; B, globule which has become free by strangulation. (X1300).

FIG. 6. Longitudinal section throughout the middle of the seminal vesicle: *cm*, circular muscles; *bm*, branching muscles; *nep*, nucleus. (X650).



Severin and Severin.